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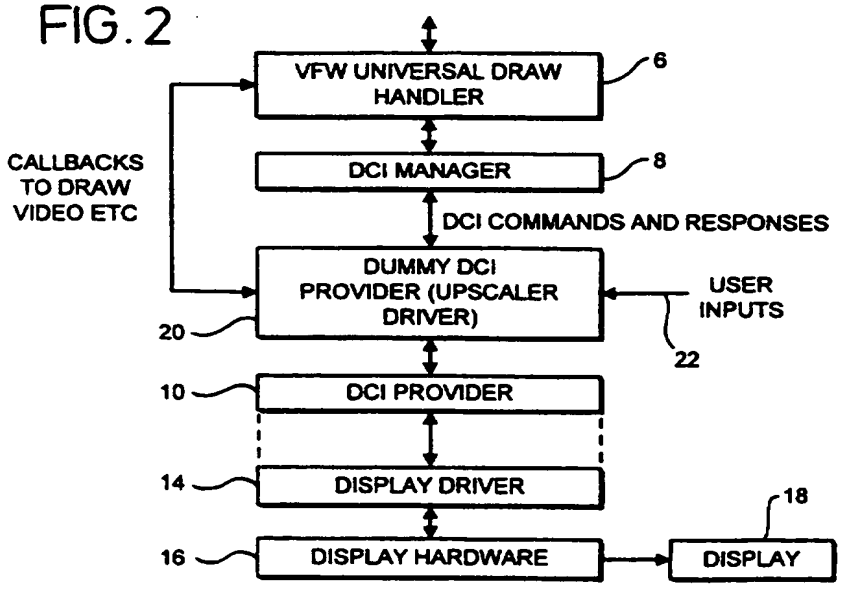
(54) COMPUTER DISPLAY INCORPORATING MOVING VIDEO IMAGES

(57) A computer display system for displaying a sequence of video images in at least a portion of a graphic display comprises means for receiving the sequence of video images. The images may be from either an external source or from a program running on a computer. A set of data defines a predetermined size and position of the portion of the graphic display in which the video images are to be displayed. Video images are inserted into the thus defined portion. Furthermore, the data defining the size and position of the portion for graphic display can be selectively intercepted and modified thereby changing the position and size of the portion of the display into which the video images are inserted.

In one embodiment video images are primarily displayed in a first mode. Changes in video image data as monitored to determine when playback of the sequence of images commences or ceases. Playback switches to a second mode of display in response to commencement of playback and then reverts to the first mode of display in response to termination of playback of a sequence of video images.

FIG. 2



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

FIG. 1

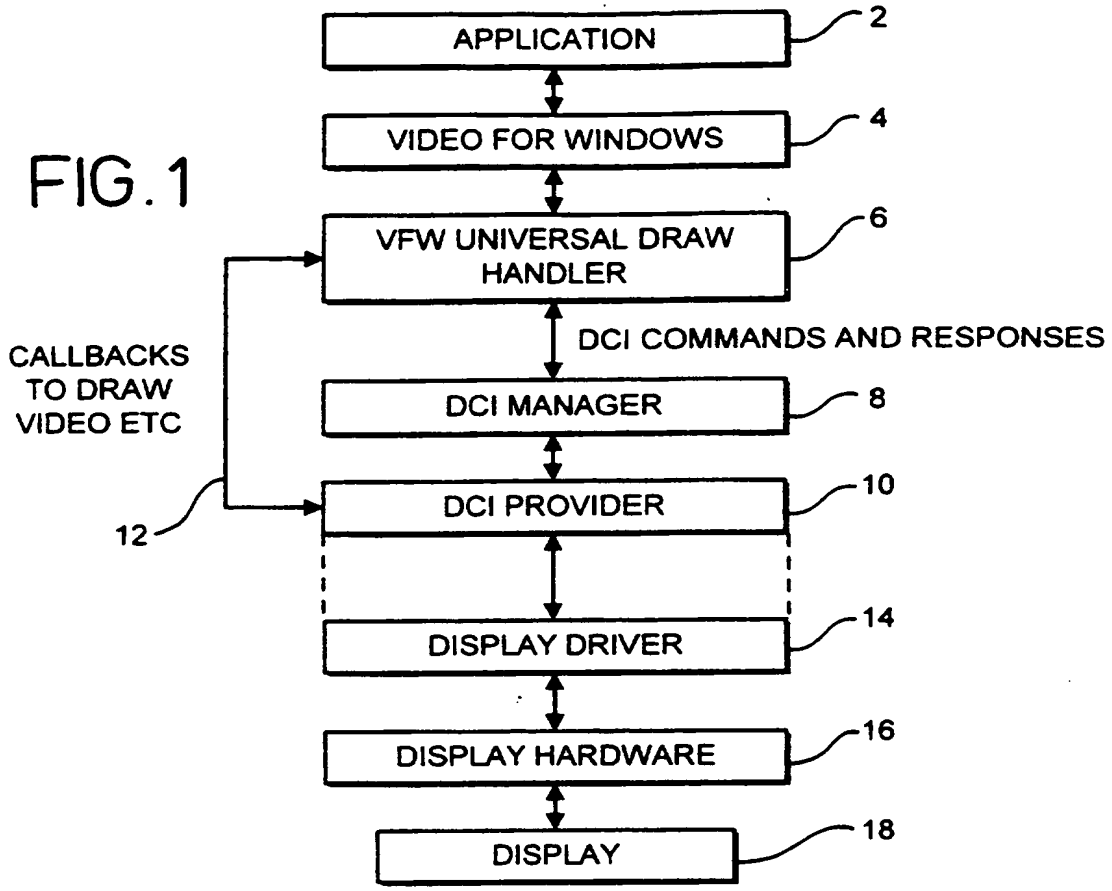
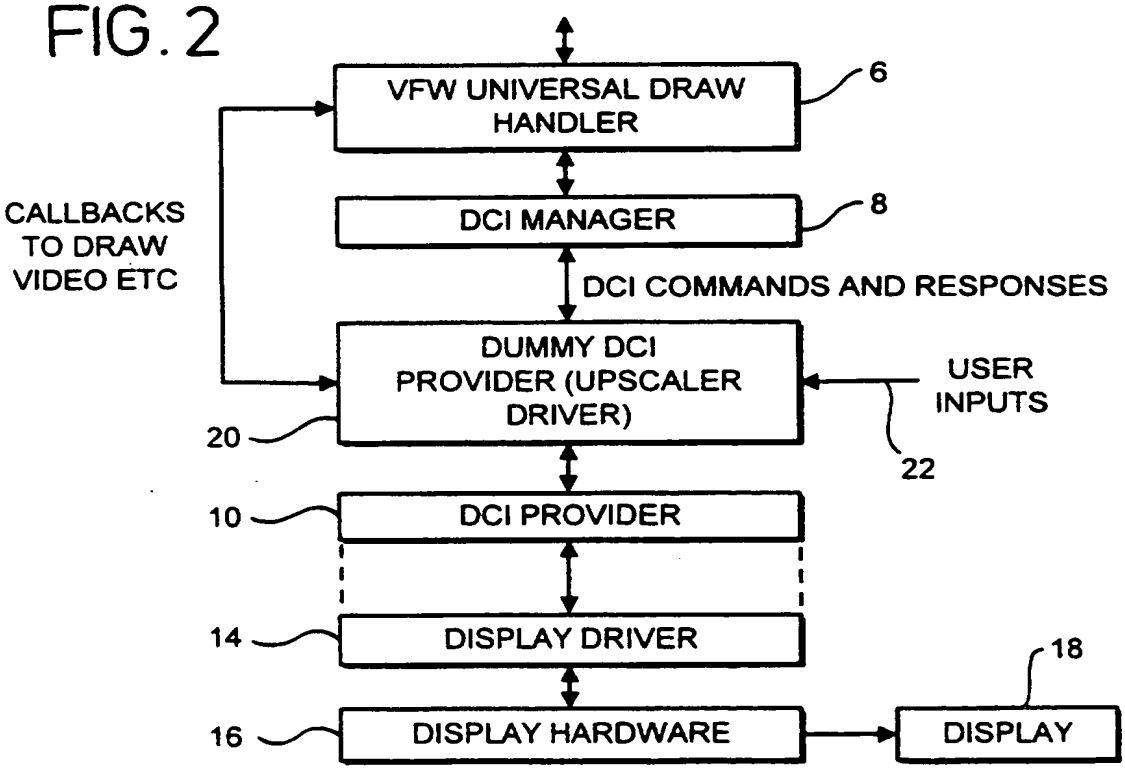


FIG. 2



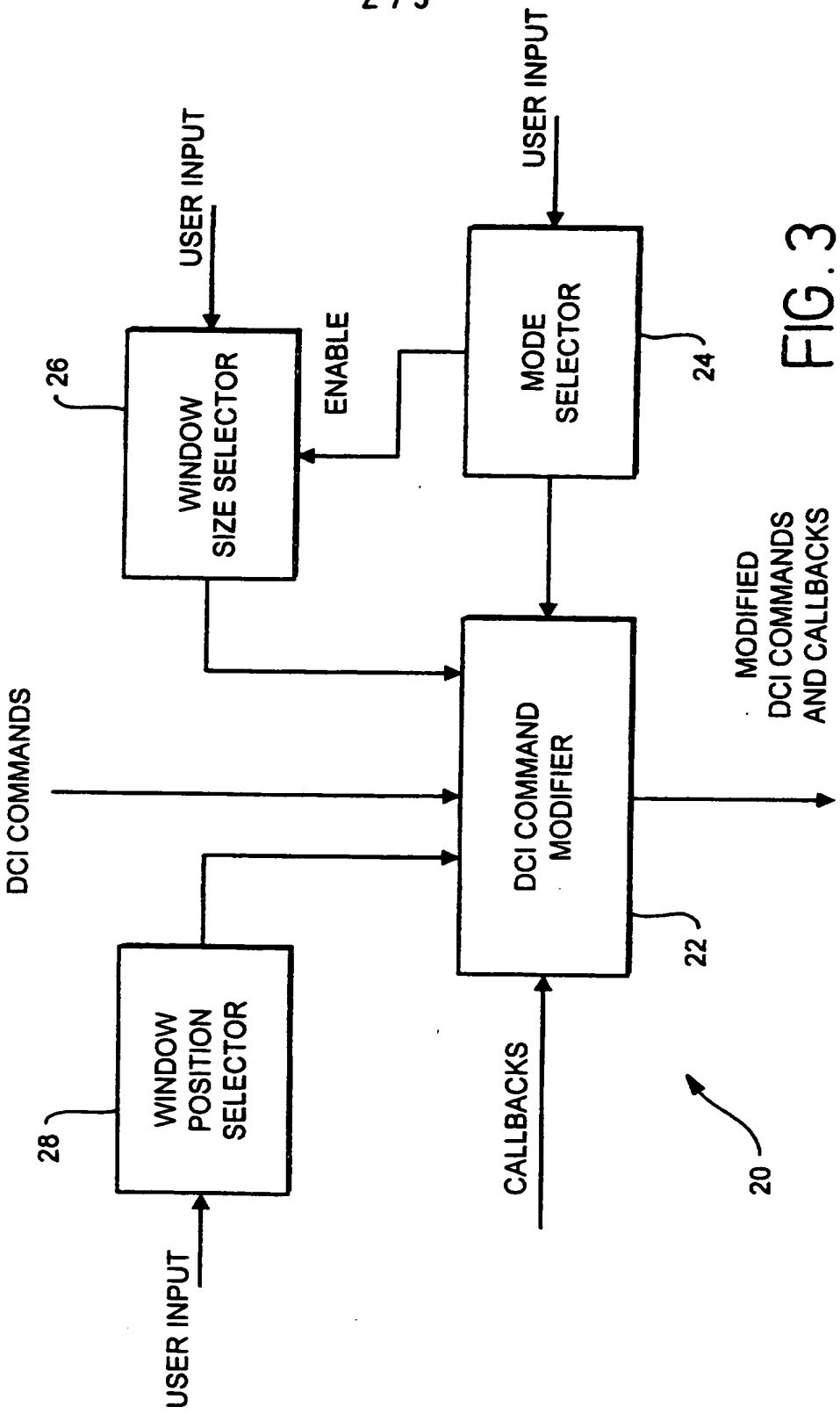


FIG. 3

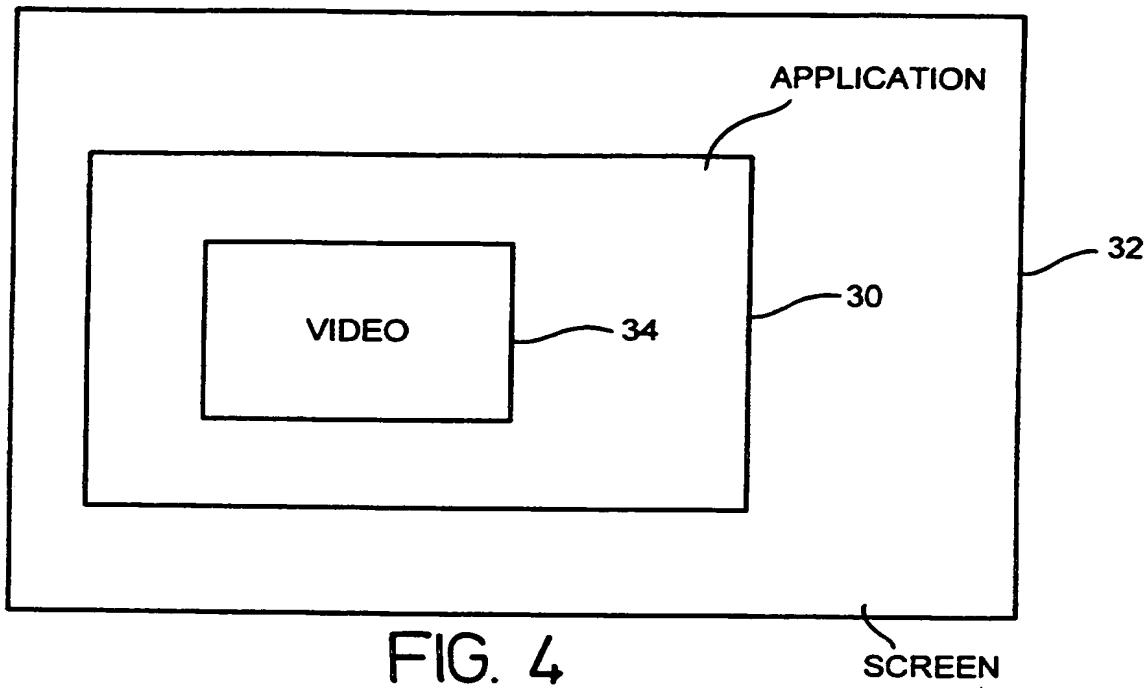


FIG. 4

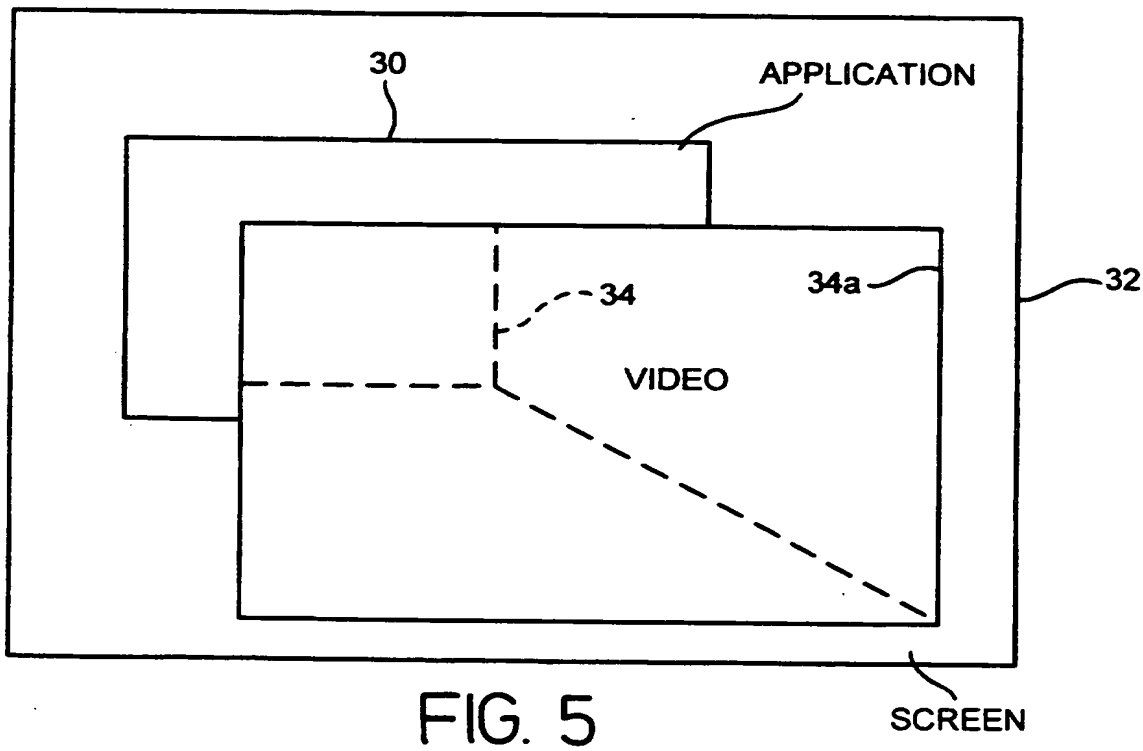


FIG. 5

COMPUTER DISPLAY SYSTEMS

This invention relates to computer display systems and in particular to computer display systems which enable moving video images to be displayed in a portion of a graphic display.

As multimedia computer systems have been developed in recent years it has become necessary to include moving video displays within graphic displays in computers. The video source material for said displays is usually compressed digital video. A plurality of compression techniques and playback options exist. Playback may be assisted by dedicated hardware, for example an MPEG (Motion Picture Experts Group) decoder or alternatively may use the standard graphics hardware already supplied on personal computers. An example of the latter case is the Microsoft (registered trade mark) Video for Windows (VfW) package which is designed to provide a user with the ability to display video images in the Microsoft Windows operating system on a standard PC, without the need to add on video hardware. This type of facility is generally referred to as software video.

The performance limitation of software video is largely one of available bandwidth. Factors which effect this include image size, frame rate, bit-depth and picture complexity. To limit bandwidth video designed for software playback is typically produced at reduced frame rates of the order of 10 to 15 frames per second rather than the usual 25/30 frames per second. Also, to limit the bandwidth, the bit-depth of the video for software playback is usually 16 bits. This provides the best compromise between image quality and data rate. The complexity of the image being viewed has less impact and it usually not a factor which can be easily changed. The other key parameter is therefore image size, that is to say the size of the area on the screen used for video playback. With the current Microsoft Video for Windows package this must usually be limited to 320 by 240 pixels to provide playback of acceptable quality at a frame rate of 15 frames per second and with a bit depth of 16 bits

per pixel. Sizes larger than this will show considerable loss of resolution in the video image.

Many software application packages which use video images are themselves designed to run at a fixed screen size (e.g. 640 by 480 pixels). This is partly to simplify design and implementation and partly for historical reasons since this is the VGA standard display size. Any video data displayed in these applications will be shown in a portion of this screen area. Some application programs will enable the user to select between this smaller portion of the display area and a full screen display (640 by 480 pixels). It will therefore be appreciated that for the majority of application programs the video data may only be displayed in a small area, eg. 160 by 120 pixels, of the display and unless the particular application program allows the window to be resized in some way the user is unable to view the video image except at the pre-defined small size.

Video data is delivered to a screen for display via a display interface such as the Microsoft and Intel display control interface (DCI). Interfaces of this type receive data from the application software producing the video image as to the size of window (portion of the screen) to be used for video data and arrange for the data to be delivered to the screen in that area within a graphic display.

In our British Patent Application No. 9422913.5 we have proposed a system for upscaling video data for display on a portion of a computer display in which additional lines of video data are interpolated from the lines of source data. The system enables video data to be upscaled without loss of resolution or frame rate. However, the upscaling system is situated, effectively, between the display interface and the screen. It is therefore dependent on instructions received via the display interface concerning the size of video image it is to produce. When an application program having fixed video display sizes is running these are the sizes which will be supplied to the upscaling system and no further upscaling is possible. Thus, even with the appropriate

modification to the system to enable video upscaling without loss of resolution and frame rate (acceleration), it is not always possible to in fact upscale video images in many software packages.

Preferred embodiments of the present invention provide a system which intercepts video data and the control signals associated with it as it is sent to a display interface from an application program and enable its specified size of windows and position within a display to be altered. Thus the capability of upscaling video from any application package is possible whether or not that package has a scalable video window. In one preferred embodiment the invention enables the video window to be played back at full screen size.

In a further preferred embodiment the video window may be set to any size under the control of the user.

A control input may be provided to enable the interception of the video data and subsequent upscaling to be switched off by the user.

Preferably the interception and upscaling is automatically switched on at commencement of playback of video data and automatically switched off at the end of playback.

The invention is defined in the appended claims to which reference should now be made.

A preferred embodiment of the invention will now be described in detail by way of example with reference to accompanying drawings in which:

Figure 1 shows a schematic block diagram of a prior art arrangement for displaying video data on a computer display;

Figure 2 shows a portion of the block diagram of Figure 1 modified in accordance with an embodiment of the invention;

Figure 3 shows a schematic block diagram of the dummy DCI provider of Figure 2 embodying the invention;

Figure 4 shows schematically the area of a display specified by an application program for a video image; and

Figure 5 shows the same application with video window in the display upscaled by an embodiment of the invention.

In Figure 1 the prior art arrangement is illustrated in schematic block form. This comprises an application program 2, which includes video data, running on a CPU of a PC. Also running is the Video for Windows Software package which configures the system to enable video from the application package to be made available for display on a portion of the computer screen. The Microsoft (registered trade mark) display control interface (DCI) communicates between the Video for Windows system and the display and its associated drivers and hardware.

The components of DCI are a universal draw handler (UDH) 6 which handles the drawing of frames of video to the screen, via the DCI when it is installed, and otherwise via the conventional graphics interface provided by Microsoft Windows on a personal computer. It handles the size and position of video windows and arranges data for writing to the main screen frame buffer. It uses two types of memory in writing data to screen. This is primary and off-screen. The primary memory is the screen frame buffer in which data for display is compiled and the off-screen means is used to store video data, prior to drawing to the frame buffer. It is used, for example, for temporarily storing decompressed video data. The actual drawing of video to screen is achieved by writing data in the off screen memory into the screen frame buffer to produce a single on-screen image.

The DCI manager is used to manage commands from the UDH 6 for particular areas of main screen frame buffer for the drawing of video data. These requests are passed to a DCI provider (10) which can access the main graphics hardware (including the screen frame buffer) of the PC. In operation access to the graphics hardware is initiated by a command from the DCI manager. Once initiated video is actually sent to the DCI provider and hence to the graphics hardware via a callback signal 12.

Video data and its specified area on the display is passed by the DCI provider to the display driver 14. It then passes to the display hardware 16 and then on to the display 18. The display hardware 16 may include a system for upscaling of the type described in British Patent

Application No. 9422913.5. However, as explained above, the position and size of video windows are dictated by those specified in an application program and any upscaling implemented will only be to the sizes and positions specified in that application program.

A modified system embodying the invention is shown in Figure 2. In this a dummy DCI provider (upscaler driver) 20 is positioned between the DCI manager 8 and the DCI provider 10. This dummy DCI provider then receives from the DCI manager all commands which were intended for the original DCI provider 10 and, by means of user inputs, is able to modify the size and position of the video window selected. The three main commands are enable, disable, and control for video data. The latter commands allows the creation of the area of off screen memory for processing of video data prior to inclusion of this data in the screen frame buffer. The dummy DCI provider 20 is responsive to user inputs to modify the size of the window in the screen frame buffer to which data from the off screen memory is to be written and also to vary the position of that window.

Once the commands have been modified by the dummy DCI provider it passes them to the DCI provider 10 which then treats them in the same way as commands received in the system of Figure 1. The dummy DCI provider also replaces the various callback functions which DCI provider 10 would have sent to the UDH. This allows the dummy DCI provider to also receive callbacks from the UDH which would otherwise have gone to the original DCI provider 10, and to inspect them and if necessary change various parameters before sending them on to the original DCI provider 10.

The callbacks which are of most interest are Draw (drawing) video from the application software through to the off screen memory, SetDestination for setting video size and position, and SetClipList which defines where within the specified window in the display for video data video can actually be drawn, ie. it defines where other graphics windows are overlapping the video window and prevents writing of video data into these overlapping areas.

Once installed between the DCI manager and the original DCI provider 10 the dummy DCI provider 20 can override the SetDestination and SetClipList requests received from the application software via the UDH and set the video destination rectangle to a different position and to a different size. This is achieved as shown in Figure 3. In this there is illustrated a DCI command modifier 22 which receives DCI commands from the DCI manager 8. This DCI command modifier also receives callbacks such as SetDestination and SetClipList from the UDH 6. There are a further three user inputs. The first user input is to a mode selector 24. This enables a user to select different modes of video upscaling. These could be as follows:

1. No upscaling. In this mode the system would operate as if the dummy DCI provider 20 were not in position.

2. Full screen display. In this mode the dummy DCI provider will modify SetDestination commands to upscale the video window from an application program to fill the whole of the display area.

3. Variable window size. This is will enable a user to specify window size and window position.

The mode selector 24 sets the DCI command modifier to operate in the selective mode in response to a user input. It also sends an enable signal to a window size selector 26 and (not illustrated) a further enable signal to a window position selector 28. The window size selector and the window position selector 28 have user inputs for size and position. These user inputs may be driven by a keyboard or by a mouse.

Using the user inputs of the dummy DCI provider 20 illustrated in Figure 3 it is therefore possible for a user to control the size and position of a video window from an application program irrespective of whether or not that application program has an inbuilt facility for upscaling video windows.

As discussed above the video window specified by the user can be resizeable or can be fixed to full display size. It is preferable for any upscaling of the video

window to be triggered on commencement of playback of the video data and to end automatically on termination of video playback. To do this the DCI command modifier monitors the frequency of Draw callbacks from the UDH (a Draw callback is a call to write the next frame of video data to the off screen memory). If the DCI command modifier receives a pre-determined number of frames within a pre-determined (small) interval of time, eg. half a second, video playback is assumed to have commenced. The DCI command modifier is then activated to modify the video window to the user selected size and position, the original application video window is blacked out and upscaling is triggered. The DCI command modifier looks at the Draw commands after commencement of playback every half second, for example, and, if no change in Draw command has taken place during that period of time it is assumed that playback has ceased. The upscaled video window is then switched off and still video data is redrawn once to the original sized application window.

This triggering of switching between playback modes is not limited to switching between size of display. It can be used with other modifications of video data or may be used to switch on or off some other application software.

The effect of the upscaler driver is shown schematically in Figures 4 and 5. Figure 4 shows a software application window 30 on a screen 32. Within the application window 30 is a video window 34 of fixed size. This is the display which will be produced by the arrangement of Figure 1.

In Figure 5 a display of the type produced by the arrangement of Figure 2 is shown. In this the video window 34A is enlarged from the window 34 within the original application window 30 to a user specified size.

Actual upscaling of the video data takes place using the system of upscaling described in our British Patent Application No. 9422913.5. This ensures that irrespective of the original resolution of the video data the upscaled video data can be at the same frame rate and at the same resolution by virtue of interpolation of additional lines

of video data. Thus the enlarged video window does not display data with the block like structure associated with prior art upscaled video data.

User control of the upscaler driver can be implemented by a small control program running on the PC which is able to display a tool bar for selecting various modes of playback with a mouse. This could be arranged, for example, to have a button which switches upscaling on and off and one which switches between user defined and full screen playback. In addition the video window can be configured to contain a maximise size button and a minimise size button to allow switching between the two playback modes.

The technique described herein is not limited to use with the Microsoft display control interface (DCI) system or to Microsoft Window operating system and can be applied to any other computer video delivery systems and operating systems.

It will be clear to those skilled in the art that the embodiment of the invention described above can be implemented in either software or in dedicated hardware or with a combination of the two.

CLAIMS

1. A computer display system for displaying a sequence of video images generated by a program running on the computer system in at least a portion of a graphic display comprising means for receiving the sequence of video images, means for receiving data defining a predetermined size and position of the portion of the graphic display in which the video images are to be displayed, means for inserting the video images into the thus defined portion, and means for selectively intercepting and modifying the data defining the size and position of the said portion of the graphic display.

2. A computer display system according to claim 1 in which the intercepting and modifying means is responsive to user inputs.

3. A computer display system according to claim 2 in which the intercepting and modifying means comprises a first user input to selectively actuate the intercepting and modifying means.

4. A computer display system according to claim 3 in which the first user input is operable to select a full screen playback mode for display of the sequence of video images.

5. A computer display system according to claims 2 or 3 in which the first user input is operable to select a user defined size for the portion of the graphic display used for playback of the sequence of video images.

6. A computer display system according to claim 5 including means responsive to a second user input for selecting the size of the said portion of the graphic display.

7. A computer display system according to claim 6 including means responsive to a third user input for

selecting the position of the said portion of the graphic display.

8. A method for displaying a sequence of video images generated by a program running on the computer system in at least a portion of a graphic display comprising the steps of receiving the sequence of video images, receiving data defining a predetermined portion of the graphic display into which the video images are to be inserted, inserting the video images into the said portion, and selectively intercepting and modifying the data defining the said portion of the graphic display.

9. A method for automatically switching between first and second display modes for video images on a graphic display comprising the steps of displaying the video images in a first mode, monitoring changes in the video data to determine whether playback of a sequence of images has commenced or ceased, switching to a second mode of display in response to commencement of playback of the sequence, and switching back to the first mode of display in response to termination of playback of a sequence of video images.

10. A method according to claim 9 in which the first mode of display comprises inserting video images into a first portion of the graphic display and the second mode of display comprises inserting the images into a second larger portion of the graphic display.

Amendments to the claims have been filed as follows

1. A computer display system for displaying a sequence of video images in at least a portion of a graphic display comprising means for receiving the sequence of video images, means for receiving data defining a predetermined size and position of a portion of the graphic display in which the video images are to be displayed, means for inserting the video images into the thus defined portion, and means for selectively intercepting and modifying the data defining the size and position of the said portion of the graphic display.

2. A computer display system according to claim 1 in which the intercepting and modifying means is responsive to user inputs.

3. A computer display system according to claim 2 in which the intercepting and modifying means comprises a first user input to selectively actuate the intercepting and modifying means.

4. A computer display system according to claim 3 in which the first user input is operable to select a full screen playback mode for display of the sequence of video images.

5. A computer display system according to claims 2 or 3 in which the first user input is operable to select a user defined size for the portion of the graphic display used for playback of the sequence of video images.

6. A computer display system according to claim 5 including means responsive to a second user input for selecting the size of the said portion of the graphic display.

7. A computer display system according to claim 6 including means responsive to a third user input for selecting the position of the said portion of the graphic display.

8. A method for displaying a sequence of video images in at least a portion of a graphic display comprising the steps of receiving the sequence of video images, receiving data defining a predetermined portion of the graphic display into which the video images are to be inserted, inserting the video images into the said portion, and selectively intercepting and modifying the data defining the said portion of the graphic display.

9. A method for automatically switching between first and second display modes for video images on a graphic display comprising the steps of displaying the video images in a first mode, monitoring changes in the video data to determine whether playback of a sequence of images has commenced or ceased, switching to a second mode of display in response to commencement of playback of the sequence, and switching back to the first mode of display in response to termination of playback of a sequence of video images.

10. A method according to claim 9 in which the first mode of display comprises inserting video images into a first portion of the graphic display and the second mode of

display comprises inserting the images into a second larger portion of the graphic display.

11. A computer display system for displaying sequence of video images in at least a portion of a graphic display substantially as herein described with reference to the accompanying figures.

12. A method for displaying a sequence of video images in a computer system in at least a portion of a graphic display substantially as herein described.

13. A method for automatically switching between first and second display mode for video images on a graphic display substantially as herein described.

The Patent Office

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Application No:	GB 9503959.0	**Examiner:**	R F KING
Claims searched:	9 AND 10	**Date of search:**	21 September 1995

Patents Act 1977
Further Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.N): H4F[FDCE, FGG, FGH, FGJ]; H4T[TCHA, TCHX]

Int Cl (Ed.6): H04N 5/45, 5/92, 9/~~98~~87; G09G 5/14

Other: ONLINE DATABASE: WPI.; H4T Library; H4F Library

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	WO 9401964 a1 [BELL ATLANTIC] See abstract.	9

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.